ASSESSING THE TOLERANCE CAPABILITY TO HEAVY METALS BY *Buddleja cordata*

A. Nieto-Trujillo[a], H. Arano-Varela[a], L. Buendía-González[b], J. Orozco-Villafuerte[c], F. Cruz-Sosa[a], M.E. Estrada-Zúñiga[b]
[a] Departamento de Biotecnología, Universidad Autónoma Metropolitana-Iztapalapa, México D.F., CP 09340, México
[b] Facultad de Ciencias, [c] Facultad de Química, Universidad Autónoma del Estado de México, Toluca, Estado de México, México, [b] CP 50200, [c] C.P. 50120. * E-mail: lena21382@yahoo.com.mx

Key words: Buddjeja cordata, tolerance, heavy metals

Introduction. The environmental pollution, associated to anthropogenic activities, has become as an increasing problem which more serious consequences are related to the accumulation of toxic compounds such as heavy metals (HM). The HM can cause adverse effects to human health until to provoke death (1). So, a variety of attempts are carried out to restore polluted areas, in which phytoremediation is included. It is a technology based on using plants that are able to stabilize, remove, translocate and/or accumulate HM contained in high amounts in soils, sludge and sediments (2,3). Mechanisms associated to that ability are rizodegradation, phytoextraction and phytostabilization and the *in vitro* culture has significantly contributed to elucidate them. Also, this technique represents a useful researching source to identify species possessing a phytoremediation potential (4). *Buddleja cordata* is a species that can grow in habitats that has been disturbed by anthropogenic activities (5).
The aim of the present work was to determine the *in vitro* tolerance capability to HM (Cd, Cr and Pb) by *B. cordata*.

Methods. *B. cordata* micropropagated plantlets were provided by UAM-Iztapalapa. Plantlets, under sterile conditions, were grown on culture medium supplied of salts source of the HM (Cd, Cr and Pb) at controlled environmental conditions. After 30 d of culture, the plantlets were harvested, and separated into aerial parts and roots. The resulting segments were weighted and dry-oven. Length and weight data were recovered to determine tolerance parameters (relative growth rate, RGR; tolerance index, TI; and root density, RD). All the experiments were done by duplicate, and every treatment consisted of 10 plantlets. The resulting data were statistically analyzed.

Results. The HM addition affected the morphology of plantlets treated with Cd, Cr and Pb. Also HM, decreased the biomass production and length decreased when it was increased, in comparison with non HM-treated (control) plantlets. Further, the tolerance parameters were significantly affected in HM-treated plantlets. The RGR values of 0.20, 0.21 and 0.20 for Cd, Cr and Pb, respectively, were determined at the higher concentration of HM tested (Table 1). The TI was significantly affected under Cd and Pb (0.48 and 0.73, respectively), while it was not affected under Cr at the higher HM tested concentration (Table 1). The RD was increased under the two lower HM concentrations tested for the three HM, but at the higher HM concentration, RD was increased with Cr, decreased with Cd and not affected with Pb (Table 1). The RGR, TI and RD parameter permits the assessment of HM tolerance as it states differences, as a ratio, in biomass and/or length reached under HM-growth regarding control (6), thus the toxicity of HM observed in *B. cordata* plantlets followed the order: Cd>Pb>Cr. The found results are similar or better to that reported in *Prosopis laevigata* seedlings cultured under *in vitro* conditions with the same HM (7,8). Interestingly, the results derived from *P. laevigata* showed that the HM tolerance capability was due to the high accumulation taking place in organs, evidencing its intrinsic potential for being a hyperaccumulator species of Cd, Cr and Pb (7,8). Might be *B. cordata* possess an intrinsic mechanism that conferred the ability to tolerate high concentrations of the Cd, Cr and Pb. Future experiments will be followed to quantify the amount of HM accumulated in the organs of *B. cordata*.

Table 1. Tolerance parameters to HM by *B. cordata*

Treatment (mM)		RGR	TI	RD
Control (without HM)		1 ± 0.03^{d}	1 ± 0.06^{d}	13.06 ± 0.91^{b}
Cd	0.03	0.19 ± 0.02^{a}	0.86 ± 0.05^{c}	46.86 ± 4.45^{c}
	0.06	0.18 ± 0.01^{a}	0.66 ± 0.08^{b}	44.97 ± 3.82^{c}
	0.10	0.20 ± 0.02^{a}	0.48 ± 0.05^{a}	2.62 ± 0.18^{a}
Cr	0.50	0.27 ± 0.03^{b}	1.08 ± 0.12^{d}	66.37 ± 4.24^{d}
	1.00	0.35 ± 0.02^{c}	1.78 ± 0.12^{e}	78.53 ± 4.38^{e}
	2.00	0.21 ± 0.02^{a}	1.16 ± 0.09^{d}	$72.50\pm5.80^{d,e}$
Pb	0.50	0.25 ± 0.01^{b}	$0.79\pm0.04^{b,c}$	60.47 ± 6.22^{d}
	1.00	0.27 ± 0.00^{b}	0.64 ± 0.06^{b}	61.93 ± 5.08^{d}
	2.00	0.20 ± 0.02^{a}	0.73 ± 0.06^{b}	14.85 ± 0.89^{b}

Mean values with the same letter within columns are not statistically different using Tukey-Kramer test (α=0.05)

Conclusions. *Buddleja cordata* was able to tolerate high contents of Cd, Cr and Pb, following toxicity the order: Cd>Pb>Cr.

References.

1. Schell LM, Burnitz KK, Lathrop PW, (2010), *Annu Hum Biol*, 37:347-366.
2. Tsao DT, (2003), *Adv Biochem Eng Biotechnol,* 78:1-50.
3. Pilon-Smits E, (2005), *Annu Rev Plant Biol,* 56:15-39.
4. Doran PM, (2009), *Biotechnol Bioeng,* 103:60-76.
5. Quiroz A, Espinosa-García F, Ilangovan K, (2002), *Bull Envirom Contam Toxicol,* 68: 862-869.
6. Baker KF, (1987), *Annu Rev Phytopathol*, 25:67-85.
7. Buendía-González L, Orozco-Villafuerte J, Cruz-Sosa F, Barrera-Díaz CE, Vernon-Carter EJ, (2010), *Bioresour Technol*, 101:5862–5867.
8. Buendía-González L, Orozco-Villafuerte J, Estrada-Zúñiga ME, Barrera Díaz CE, Vernon-Carter EJ, Cruz-Sosa F, (2010), *Rev Mex Ing Quim* 9:1-9.